

THE CRUSHED STONE JOURNAL

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"Retreading" Our Highways

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A REMARKABLE METHOD for transforming old, worn-out highways into exceptionally smooth riding surfaces has been evolved within the past few years. This method, known as the "Retread" method gives so much promise of excellent service at low cost that it merits full investigation by every highway engineer in the country who is interested in preserving and greatly enhancing the service value of the old highways under his jurisdiction. Macadam or gravel roads worn so rough that travel over them is accomplished with difficulty may be given a reasonably durable surface, as smooth and even smoother than the very best pavements, at a cost averaging not over \$3,000 to \$5,000 per mile for a 20-foot width.

There are thousands of miles of highways which can be improved by this method at very low cost. These are highways upon which an expensive pavement or even a bituminous macadam surfacing is not justified but which require a treatment more durable than a bituminous surface treatment. The "Retread" method has characteristics intermediate between those of a bituminous surface treatment and a bituminous macadam and it is said to have been evolved first in Pennsylvania to preserve an investment in old shale and broken stone roads which were too dusty and too expensive to maintain under the volume of traffic they were receiving.

The "Retread Method"

The procedure to be followed in forming a "Retread" surfacing may be extremely simple and carried out with almost no equipment, or it may be elaborated if equipment is available and if the extra expense of more elaborate methods is warranted. Essentially, "Retread" is an inexpensive type of surfacing and undue elaboration in the construction methods will increase the construction costs. Such a surfacing should be built where something better than a bituminous surface treatment is needed but where the expense of a bituminous macadam is not warranted. The

idea is to obtain as durable and smooth a surface as possible with the least expenditure of funds. A number of variations in construction methods are permissible but the following is a method which has been used very successfully and is one which will give good results at low cost and with the least probability of trouble. It has been used in Pennsylvania and other states very extensively.

Operations Followed in Constructing "Retread" Surfacing

1. Scarify and re-shape old base adding additional stone if necessary, or merely sweep base clean of dust and dirt if it is of proper cross-section and grade, and well solidified.
2. Spread layer of stone about 2 inches thick (use $\frac{3}{4}$ in. to $1\frac{1}{4}$ in. stone).
3. Treat with 0.5 to 0.75 gal. per sq. yd. of bitumen, either tar or cut-back asphalt. (Fig. 1.)
4. Blade surface to proper cross-section.
5. Continue blading to maintain desired cross-section until the surface begins to set.
6. At the end of four or five days after the surface has set, apply about 0.25 gal. of bitumen followed by light cover of stone chips. Traffic is permitted to operate continuously during the entire construction.

The above method may be varied depending upon the equipment available and the expense which seems warranted to obtain the desired results. For instance, if the job is a small one and a blade grader is not available the proper cross-section may be maintained and the ruts formed by traffic may be kept reduced by means of hand rakes during the first few days when the surface is drying and setting.

On the other hand, the method may be elaborated and unquestionably, a smoother riding surface will be produced if both a blade and a roller are used. The roller may follow immediately after the blade, after

the first application of the bitumen and the rolling may be continued after the blade can no longer operate due to the setting up of the surface. The roller wheels may be prevented from sticking to the freshly coated stone by keeping them moistened with very little water fed to them from a small tank holding a few gallons. After the second application of 0.25 gal. per sq. yd. of bitumen has been covered with chips, the surface is again rolled. The roller effects a quicker compaction of the surface than when it compacts under traffic alone and a smoother riding surface will result. (Figs. 2 and 3.) If traffic can be kept off the road during construction a still better surface will be obtained.

Some Construction Details

In following the above general procedure there are some construction details to be considered.

Preparation of the Base

The first essential is a good hard base. Old broken stone roads form excellent bases provided they have

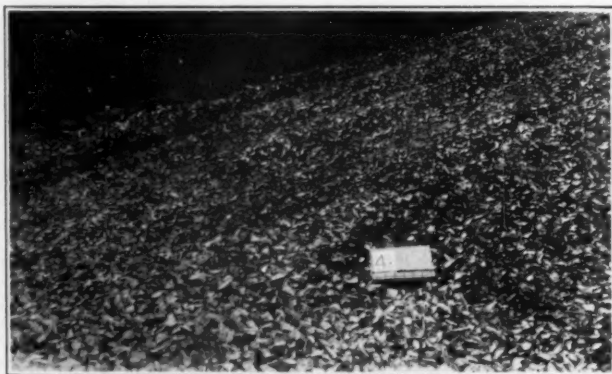


Fig. 1—Appearance of $\frac{3}{4}$ to $1\frac{1}{4}$ inch stone just after first treatment of $\frac{3}{4}$ gallon of tar or cut-back asphalt. The next step is rolling or preferably blading and rolling. Then will follow a second treatment of 0.25 gallon of bituminous binder, then a cover of $\frac{1}{4}$ to $\frac{3}{4}$ inch chips, finally, more rolling.

not been worn so thin that very little metal remains. Roads which have been maintained as traffic bound surfaces provide excellent support for "retread" construction for they are quite apt to have uniformly high supporting value. If there are obvious weak spots or places requiring drainage these should first be given attention. If there are serious ruts or bumps, the base should be repaired to remove them. Major defects should be repaired but minor roughness will need no attention.

Should the old road not be sufficiently true to cross-section and in such poor condition that it will not be economical to attempt patching it with crushed stone, the entire road should first be scarified and re-shaped.

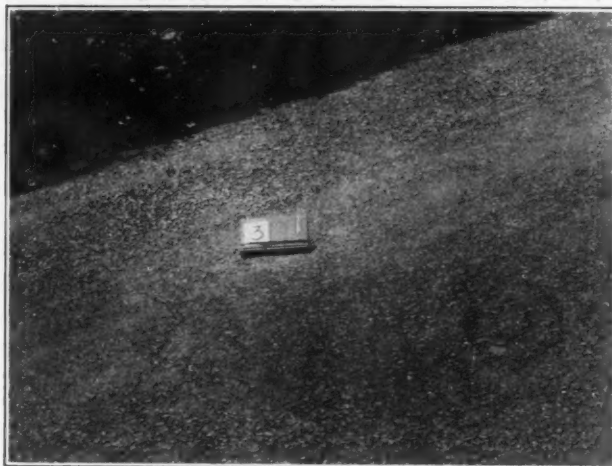


Fig. 2—Appearance of "Retread" surface constructed of $\frac{3}{4}$ to $1\frac{1}{4}$ inch stone, 2 inches thick, $\frac{3}{4}$ gallon of tar, rolled immediately and continuously for one day. A week later, $\frac{1}{4}$ gallon tar covered with 30 pounds of $\frac{1}{4}$ to $\frac{3}{4}$ inch chips per square yard. Finally rolled.

It is not advisable to scarify to a greater depth than four inches and care should be taken that the base is not broken clear through to the foundation by the scarifier. After thoroughly loosening the top surface it should be shaped to proper cross-section and re-rolled. If immediate compaction is not necessary any stone added to the surface may be compacted by proper dragging and maintenance of the road under traffic. A crown of three inches in a 20-foot road is sufficient. Finally any excess of fine material should be removed from the surface by a mechanical sweeper or a light grader. The surface is now ready for an application of stone.

As a general rule, the more compact and smoother the base, the better will the surfacing behave under traffic for it will then be more durable and, moreover, will maintain its original smoothness. On the other

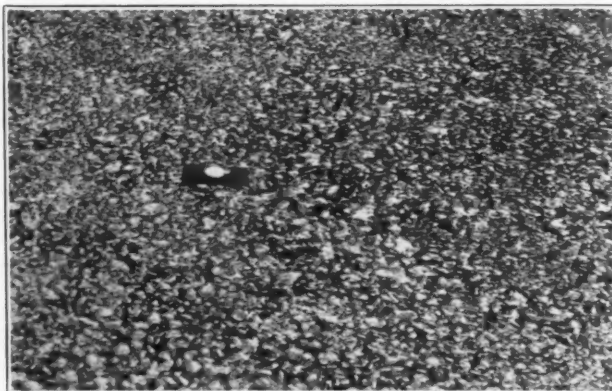


Fig. 3—Typical appearance of "Retread" Surface. Such a surface has exceptionally smooth-riding and non-skid properties.

hand, an inadequate base will permit roughness to develop in the surface. It would seem, therefore, that the expense involved in preparing a smooth, solid base is warranted and the more elaborate and expensive the surfacing the greater should be the care in the base preparation.

Size of Stone

The size of stone advocated in the "retread" surfacing may be called commercially, $\frac{3}{4}$ — $1\frac{1}{4}$ in. stone. At present this size has different commercial names in different sections of the country. The idea, however, is to obtain stone of an average size of $\frac{3}{4}$ to 1 in. with a small amount of fine material. Stone conforming with the following specifications will be suitable.

Commercial Size	Per Cent Passing Circular	Opening	Laboratory Screens
	$\frac{3}{4}$ in.	1 in.	$1\frac{1}{4}$ in.
$\frac{3}{4}$ — $1\frac{1}{4}$	0-15	25-75	95-100

Quality of Stone

The stone should be of good quality such as required for bituminous macadam where a percentage of wear of 6.0 is permissible. Soft stone necessarily breaks up under the action of the roller and traffic more than the harder, tougher varieties, so that when soft stone is used it should have larger average size than in the case of the harder varieties.

Spreading the Stone

The stone may be dumped on the surface of the road from trucks and spread with a small grader or the tail board of the truck may be regulated to spread the proper thickness of stone as the truck moves forward. Better still, a spreading device may be used but this is not at all necessary. If there are any irregularities in the old base these will be filled in by the subsequent manipulation of the surfacing materials. The aim should be to obtain an average thickness of layer of 2 inches. It is not felt that a thinner layer than this should be used, for greater economy will result with the thicker layer. Nor should the layer be much thicker than 2 inches for otherwise the expense is made to approach a figure which might warrant still better construction such as bituminous concrete or bituminous macadam.

Applying Bituminous Material

The bituminous material used may be either tar or cut-back asphalt complying with the specifications which follow. A pressure distributor should be used and the ordinary precaution for distributing should be exercised to obtain uniformity.

Specifications for Bituminous Materials

Refined Tar for Hot Application

Type TC-4-25

Grade

I. One grade only is covered by this specification.

Material and Workmanship

II. Material supplied under this specification shall be produced from gas-house, coke oven, water-gas, and / or similar tars.

General Requirements

III. The tar shall be homogeneous.

Detail Requirements

IV. Physical and Chemical Properties.

The refined tar shall meet the following requirements:

- Specific gravity 25°/25°C. (77°/77°F.) 1.100 to 1.180.
- Specific viscosity at 40°C. (104°F.) 25.0 to 35.0.
- Total distillate by weight:
 - To 170°C. (338°F.) not more than 3%
 - To 270°C. (518°F.) not more than 30%
 - To 300°C. (572°F.) not more than 40%
 - Softening point of residue, not more than 60°C. (140°F).
- Bitumen (soluble in carbon disulphide),
Not less than..... 90%.
- Water no more than 2.0%

Cut-Back Asphalt, Liquid Asphalt A. C.

It shall be homogeneous in character and free from water.

Flash Point (open cup) not less than..... 90°F.

Specific Viscosity..... 20 to 100 at 122°F.

Separation of Asphalt Base from Distillate Flux

(a) Distillate by Volume

Per cent off at 437°F. not less than... 10

Per cent off at 600°F. not less than... 20

Per cent off at 680°F. not less than... 35

(b) Characteristics of residue from distillate at 680°F.

Penetration at 77°F. 100 g. 5 sec.... 70 to 110

Per cent Bitumen, soluble in carbon

disulphide, not less than..... 99.0

Ductility at 77°F. not less than..... 100

When applied, this asphalt shall be at such a temperature that it will readily flow on the road surface or be incorporated with the aggregate.

Cost of "Retread" Surfacing

The total cost will, of course, depend upon the amount of work put into the preparation of the surface. A unit cost for the completed 2-inch surface of 40 to 45 cents per square yard is at present a fair average figure.

Maintenance of "Retread" Surfacing

Possibly there may be spots that will require maintenance during the first year due to raveling. In this case a cold patch mix of stone will be suitable for the repair job. During the second year, the surface may be given a surface treatment of $\frac{1}{4}$ to $\frac{1}{2}$ gal. per sq. yd. covered with 30 to 60 pounds of stone chips. In lieu of this a second course of "retread" may be applied, following exactly the methods used in the first course. The first course by this time will have become well compacted and will form a good solid base for the second application. In this way a thick, durable wearing surface may be built up which compares very favorably with a bituminous macadam and its cost has been spread over two payments. Communities having insufficient funds to construct the type of pavement which will ultimately be demanded by traffic may utilize the "retread" method to build up a smooth durable surface gradually and thus more miles of suitable roads are made immediately available.

There are many thousands of miles of secondary roads to which the foregoing "retread" method is applicable. It is absurdly simple and is giving such excellent results that it is certain to gain great favor within a short time. Certainly so excellent a method merits full attention by all highway engineers.

Modification of the "Retread" Top (Indiana Method)

The preceding method of "retread" construction has been most widely used with successful results. It seems fitting, however, to describe a modification of the "retread" top now being tried by the Indiana State Highway Commission. It is mentioned at this time as an illustration of a variation in the simple "retread" method carried on almost with the elaboration and meticulous attention to detail used in the construction of the most expensive type of road surface. The method is such a wide departure from the "retread" idea that it is a question if it should not be given another name. It, in fact, closely approaches bituminous macadam construction. The minute care and attention to construction details unquestionably improves the riding qualities of the road, but roads constructed in accordance with this method are perhaps too young to warrant any prediction as to their ultimate success or to state whether or not this method may require some alteration. It should be pointed out that the size of stone recommended in the Indiana method is most suited to the softer varieties of stone which are expected to break to some extent under the



Fig. 4—Indiana "Retread" just after first application of bituminous binder. There was no preliminary rolling of this stone before applying bitumen.

roller. It is also pointed out that with this method a comparatively small amount of bituminous material is specified and for this reason weak spots may develop which will require maintenance as the surface is compacting under traffic. It probably would be imprudent to use as small an amount of bitumen as specified under the Indiana method unless adequate maintenance forces are continuously available to repair imperfect spots as soon as they appear.

Steps in Construction of Indiana "Retread"

1. Scarify and reshape old base if necessary or merely sweep it clean of dust and dirt.
2. Spread layer of stone to the desired thickness (2 in., $2\frac{1}{2}$ in. or 3 in. loose, use $1\frac{1}{4}$ -2 in. stone) (1 in. loose, use $\frac{3}{4}$ - $1\frac{1}{4}$ in. stone).
3. Roll stone lightly.
4. Apply first treatment of bitumen (about 0.4 gal. per sq. yd.). (Fig. 4.)
5. Blade immediately only disturbing top layer. (Fig. 5.)



Fig. 5—Indiana "Retread." Blading just after first application of bituminous material. Note that the blade is raised so as to disturb only the top layer of the surface.

6. Roll immediately after blading and again after two days. (Fig. 6.)
7. Fill surface voids with stone chips applied sparingly. (Fig. 7.)
8. Apply light treatment of bitumen after first treatment has set. (About 0.2 gal. per sq. yd.)
9. Drag surface, preferably with light drag.
10. Roll chips into surface after dragging.
11. In about two weeks apply still lighter coat of bitumen (about 0.15 gal. per sq. yd.).
12. Cover sparingly with chips and roll thoroughly. (Fig. 8.)

Quality of Stone

The quality of stone should be similar to that used for bituminous macadam construction for which a per cent of wear of 6.0 is permissible.

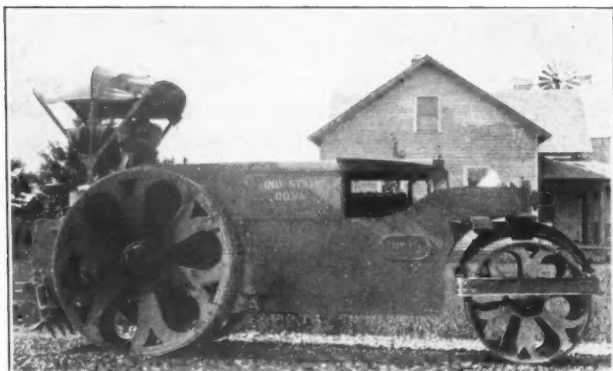


Fig. 6—Indiana "Retread." A ten-ton roller follows immediately after the blade. Rolling will again be given at the end of two days and continued over a period of several days.

Thickness of Stone Layer

The thickness of layer will be governed to a considerable extent by the service required of the "retread" and in turn the size of the stone will likewise depend upon the thickness of layer selected. Heavy service requires a thicker layer of larger stone having greater stability. The following thicknesses with the corresponding sizes of stone should give good results:

TABLE I.

Loose Depth of Stone (inches)	Commercial Size of Stone (inches)	Per Cent Passing Size of Circular Opening Laboratory Screen							
		1/4	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2
1	3/4-1 1/4			0-15	25-75	95-100	100		
2, 2 1/2 or 3	1 1/2-2 1/2		0-2			0-15		95-100	100

The thicker layers with larger stone more closely approach a bituminous macadam in their service value while the thinnest layer with smaller stone is closer in value to a bituminous surface treatment, although much better than such a treatment. The traffic

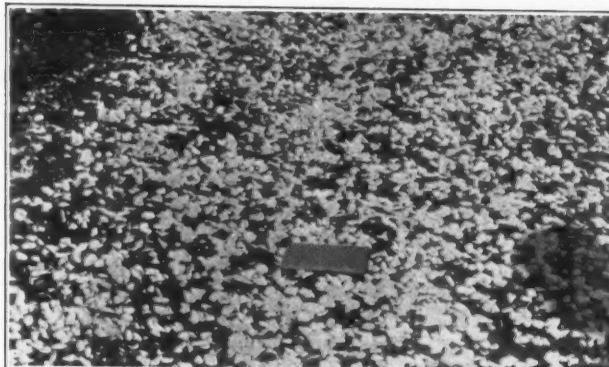


Fig. 7—Indiana "Retread." After completion of initial rolling, screenings are applied sparingly. These will be dragged over the surface and rolled after second application of bitumen. (About 0.2 gal. per sq. yd.)

requirements will govern the selection of the proper thickness to use.

Method of Spreading

The method of spreading described on page three under the more usual method of "retread" construction may be employed in the Indiana "retread."

Rolling the Stone After Spreading

After spreading as above described it is desirable to roll the stone, not thoroughly, but just enough to smooth it out and key it together. Care should be taken not to roll to such an extent that the stone is shattered or compacted tightly together. This is an undesirable condition. The initial rolling is frequently omitted but its expense is probably justified by the superior results obtained.

Applying Bituminous Material

Either tar or cut-back asphalt complying with the specifications given on pages six and seven is applied

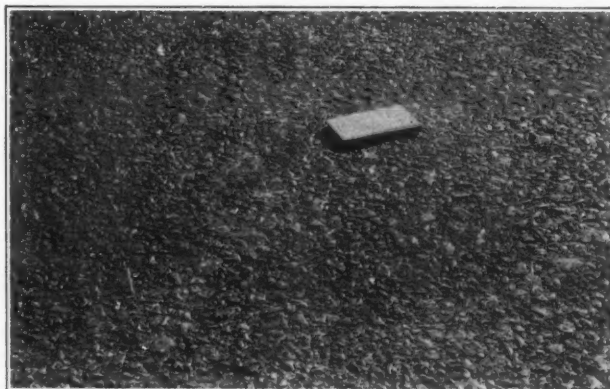


Fig. 8—Indiana "Retread." After the third application of bituminous binder more screenings are applied and rolled. Note the non-skid appearance. The dragging and rolling have produced an exceptionally smooth-riding surface.

with a pressure distributor in as uniform a manner as possible. The amount to be applied depends upon the size of stone and thickness of layer used. An estimate of the amounts necessary for the various thicknesses is given in Table II, below. Blading of the surface is begun immediately following the application of the bitumen and before it has taken any set. It is important to get all blading accomplished before the bituminous material sets to avoid balling up in front of the blade.

Blading and Rolling

In blading, a grader having a 10-foot blade is a desirable size and may be drawn by a motor truck. The blade is so set that only the top surface of the road is disturbed and a pile of the bitumen coated stone is kept continuously in front of the blade. (See Fig. 5.) Blade to proper cross-section and roll just once with a 10-ton road roller. After a few days when the bitumen has set, roll again very thoroughly. Fill the surface voids with stone chips, either $\frac{1}{2}$ - $\frac{3}{8}$ in. or $\frac{1}{4}$ - $\frac{1}{2}$ in. in size, depending upon the size of stone used in the body of the road. These chips should be free from dust and clean. Care must be taken not to use an excess of chips. The idea should be merely to fill the surface voids. A second application of bituminous material is now given, the surface again lightly bladed or dragged with a sled drag. The chips are then rolled into the surface and several weeks later a third application of bituminous material is given, covered with chips and rolled thoroughly.

TABLE II.
Quantities of Bituminous Material Used

Loose Depth of Stone (inches)	Commercial Size of Stone (inches)	Quantity of Bituminous Material Gallons per Square Yard			
		First Application	Second Application	Third Application	Total
3	1½-2½	0.5	0.3	0.15	0.95
2	1½-2½	0.4	0.2	0.15	0.75
1	¾-1½	0.3	0.2	0.5

TABLE III.
Estimate of Quantity of Stone Required
(Based on Limestone)

Loose Depth of Stone (inches)	Commercial Size of Stone (inches)	Pounds Per Square Yard	Chips	Pounds Per Square Yard
3	1½-2½	198	¾-¾	36
2	1½-2½	132	¾-¾	25
1	¾-1½	66	¾-¾	15

Specifications for Bituminous Materials

Cut-Back Asphalt, Liquid Asphalt A. C.

(For use in all applications)

It shall be homogeneous in character and free from water.

Flash Point (open cup) not less than 90°F.
Specific Viscosity 20 to 100 at 122°F.

Separation of Asphalt Base from Distillate Flux

- (a) Distillate by Volume
Per cent off at 437°F. not less than 10
Per cent off at 600°F. not less than 20
Per cent off at 680°F. not more than 35
- (b) Characteristics of residue from distillate at 680°F.
Penetration at 77°F. 100 g. 5 sec. 70 to 110
Per cent Bitumen, soluble in carbon disulphide, not less than 99.0
Ductility at 77°F. not less than 100

When applied, this asphalt shall be at such a temperature that it will flow readily on the road surface or be incorporated with the aggregate.

Asphalt OH2

(For use in final application)

The asphalt shall meet the following requirements:

1. It shall be homogeneous, free from water, and shall not foam when heated to 175°C. (347°F.)
2. Specific gravity, 25°/25°C., not less than ... 1.00
3. Flash point, not less than 175°C.
4. Penetration 25°C. (50 g., 5 sec.) 175 to 250
5. Loss at 163°C.—5 hours (50 g. sample)
not more than 5%
(a) Penetration of residue at 25°C. not less than 50% of original.
6. Total bitumen (soluble in carbon disulphide), not less than 99%
(a) Organic matter insoluble, not more than 0.5%

Liquid Asphalt CB

(For use in final application: also in all applications if stone is comparatively large)

It shall be homogeneous in character and free from water.

Flash Point (open cup) not less than 80°F.
Specific Viscosity 100 to 200 at 122°F.
Separation of Asphalt Base from Distillate Flux

- (a) Distillate by Volume
Per cent off at 437°F. not less than 5
Per cent off at 600°F. not less than 15
Per cent off at 680°F. not more than 30
- (b) Characteristics of residue from distillate at 680°F.
Penetration at 77°F. 100 g. 5 sec. 60 to 110

Per cent Bitumen, soluble in carbon	
disulphide, not less than.....	99.0
Ductility at 77°F. not less than.....	100

When applied this asphalt shall be at such a temperature that it will flow readily on the road surface or be incorporated with the aggregate.

Refined Tar TH

(For use in final application)

Tar TH shall meet the following requirements:

1. It shall be homogeneous and free from water.
2. Specific gravity 25°/25°C.....1.18 to 1.26
3. Float Test at 32°C.....120 to 180 seconds
4. Total distillate by weight:
 - To 170°C. (338°F.), not more than..... 1%
 - To 270°C. (518°F.), not more than.....18%
 - To 300°C. (572°F.), not more than.....24%
 - (a) Softening point (Ball and Ring) of residue, not more than.....70°C.
 - (b) Specific gravity of distillate 25°/25°C., not less than.....1.03
5. Total bitumen (soluble in carbon disulphide)83% to 95%
 - (a) Inorganic matter insoluble, not over 0.5%

The tar TH shall be at a temperature between 150°F. and 200°F. when applied to the road surface.

Tar TM

(For use in first and second applications)

Tar TM shall meet the following requirements:

1. It shall be homogeneous.
2. Specific Gravity 25°/25°C.....1.13 to 1.20
3. Specific viscosity at 40°C..... 25 to 40
4. Total distillate by weight:
 - Water, not more than..... 2.0%
 - To 170°C., not more than..... 5.0%
 - To 300°C., not more than.....33.0%
 - (a) Softening point (Ball and Ring) of residue, not more than.....65°C.
 - (b) Specific gravity of distillate, not less than1.00%
5. Total bitumen (soluble in carbon disulphide)88 to 97%
 - (a) Inorganic matter insoluble, not more than0.5%

Tar TM shall be at a temperature of 125° to 150°F. when applied to the road surface.

Cost of Indiana "Retread" Method

The cost of the Indiana "retread" surfacing is dependent upon a number of factors such as extent of work required on old base, thickness of "retread" and cost of labor and materials. A fair average cost, however, lies near \$3500 to \$5000 per mile.

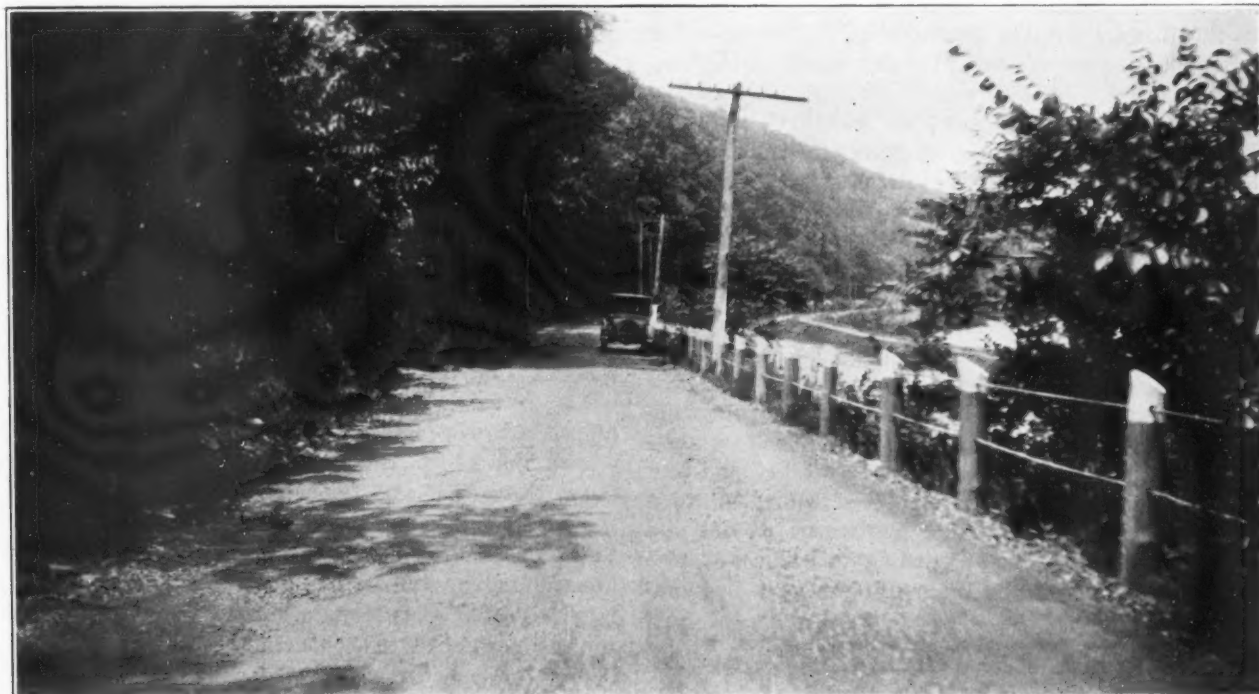


Fig. 9—An excellent riding surface produced at small expense is the final result.

Safety In the Quarry Industry¹

By W. W. ADAMS

Statistician, United States Bureau of Mines

SAFETY in the quarry industry is a matter of direct concern to 92,000 men who are employed in the industry and it is also of almost equally direct concern to their immediate families. Thus between 300,000 and 400,000 people are personally affected by the accidents that occur in connection with the annual production of stone in the United States and in connection with the crushing and other work that immediately follows its extraction from the earth. From 120 to 150 of these men are killed by accidents each year, and 14,000 of them are nonfatally injured.

Through the cooperation of the producing companies, the United States Bureau of Mines conducts an annual canvass of accidents and employment covering the quarrying of stone, and such subsequent work as crushing, rock-dressing, and the manufacture of lime and cement. This work began in 1911 and statistics covering the past 16 years are now available. These statistics are based upon reports furnished voluntarily by the producing companies on blank forms supplied by the Bureau of Mines. Each nonfatal injury reported to the Bureau involves disability of the employee for more than the remainder of the day on which the accident occurred. In other words, the Bureau's statistics are limited to what are known as "lost-time" accidents. While many of these injuries cause the employee to lose only one or two days, some of them involve the loss of several weeks or months. Taking them in the aggregate, they average about 15 days per injury. Any company whose temporary injuries average less than fifteen days each has a relatively safe plant, or is lucky, or is doing effective safety work. If deaths and permanent disabilities are drawn into the picture and given their customary equivalent weights in lost days, the average accident in the quarry industry represented a loss of 104 man-days in 1925 and 94 man-days in 1924. In this average each fatality and permanent total disability is considered equivalent to a loss of 6,000 days and each permanent partial disability 800 days, the last-named figure being borrowed from the reports of the Industrial Accident Commis-

sion of California until sufficient reports of this class of injuries accumulates in the Bureau's records to develop a new average.

In addition to the Bureau's annual canvass of accidents which is based on reports from all producing companies in all States, or as nearly all of them as we can obtain, a special and much more intensive inquiry into quarry accidents has been under way during the past two years. This study is based on full and complete reports—a separate and detailed report for each accident—from a limited number of companies. Each of these companies employs at least 25 men inside the quarry. They are the companies that are participating in the National Safety Competition which is being conducted by the Bureau of Mines. Two such annual contests have been completed, namely, that of 1925 and that of 1926. One of the purposes of the safety contest is to determine which quarry has the smallest loss of time from accidents in proportion to total man-hours of exposure. The quarry that establishes the best record receives a bronze trophy or statue known as the Sentinels of Safety which is the gift of The Explosives Engineer magazine. Credit for providing the trophy and for very material aid in connection with the contest, is due very largely to the enterprise of Mr. N. S. Greensfelder, the editor. The trophy is held for one year by the winning company, and is then surrendered to the winner of the next year's contest. Each year the name of the winning company is engraved on a pedestal of the trophy and each employee of the winning quarry receives an engraved certificate of honor issued by the Bureau of Mines and signed by the Director of the Bureau.

The Bureau's annual canvass of quarry accidents affords a broad picture of the accident situation as it effects the whole industry or any large portion or phase thereof; it also furnishes an annual account of the volume of employment required to produce the country's annual stone supply and of the total loss of life and limb as well as the loss in man-days that went into the cost of producing the stone. The more detailed reports furnished in connection with the National Safety Competition are usually supplied as a carbon

¹Paper presented before the Quarry Section of the National Safety Council at the Sixteenth Annual Safety Congress, Chicago, September 28, 1927.

copy of the report which the company is required to send to its insurance carrier or to the state compensation commission. In this way the Bureau is furnished with detailed valuable information on accidents with a minimum of inconvenience to the company.

It will thus be seen that the Bureau of Mines statistics of quarry accidents are collected by two methods from a common source, namely the quarry companies. It will also be observed that the statistics differ in scope, geographically, and in the degree of detail with which the information is supplied. From these two sources of information and similar information from other branches of the mineral industry, it is apparent that quarry accidents occur less frequently and cause a smaller loss of time in proportion to number of employees than do accidents at metal mines or coal mines. In other words, quarry work is not as hazardous as coal mining or metal mining, considering each of the three industries as a whole. Moreover, differences also exist between the hazard of different kinds of quarries. Perhaps the chief distinction in this respect is between quarries that produce dimension stone and those that produce non-dimension stone. Quarries that produce crushed or non-dimension stone have higher accident rates than those that produce dimension stone. For example, the fatality rate for the non-dimension group, in and about the quarry, in 1925, was 33 per cent higher and the injury rate was 7 per cent higher than the corresponding rates at dimension stone quarries; in 1924 the rates were respectively 76 per cent and 18 per cent higher. A comparison covering all years since 1916 shows that, without exception, the group rates for both fatalities and injuries, have been higher at stone quarries producing non-dimension stone, the excess ranging from 5 per cent in 1921 to 118 per cent in 1920 for fatal accidents and from 1 per cent in 1917 to 122 per cent in 1921 for nonfatal accidents. Moreover, possible differences in length of work day at the two classes of quarries have no material effect upon this relationship. This is shown by figures which have been compiled for quarries working uniform shifts, that is, 8 hours, 9 hours, or 10 hours.

In crushed-stone or non-dimension-stone quarries, where no care need be exercised to prevent breaking the stone, it might be expected that the rate from accidents from explosives would be higher than that in quarries producing dimension stone that is intended to be used for building or monumental purposes. This, in fact, has often been the case, as shown by the annual reports which the Bureau of Mines has received from the producers of stone. It does not, however,

fully account for the higher frequency of accidents at crushed or non-dimension-stone quarries. A comparison of the annual figures for the two classes of quarries during the past seven years, shows that some other classes of accidents also, as a rule, occur more often at quarries that produce crushed or non-dimension stone. Crushed-stone or non-dimension-stone quarries show higher injury rates for accidents caused by handling rock at the quarry face, also for accidents from falls or slides of rock or overburden. Haulage accidents also are usually more frequent at crushed-stone quarries. Accidents caused by falling objects, which records for earlier years showed were of more frequent occurrence at crushed-stone quarries, have been materially reduced during the past four years, and in 1925 the crushed-stone rate for this class of injuries was actually lower than at quarries producing monumental or building stone. A somewhat similar situation prevails as to accidents from flying objects; the rates for this type of accidents have been high for both kinds of quarries, but during the past three years the non-dimension quarries have established the better record. Machinery accidents also are among the major causes of injuries at both classes of quarries, but in the past few years the crushed-stone quarries have reduced their injury rates from this cause, and since 1922 these rates for machinery accidents have been lower than at dimension-stone quarries. The net advantage, however, still lies with quarries that produce dimension stone; that is to say, the injury rates covering all classes of accidents combined is still lower for the dimension-stone quarries.

Accident prevention is a national as well as local problem. It is therefore appropriate that national associations such as the Portland Cement Association, the National Crushed Stone Association, and others, should undertake or maintain some group action looking to the prevention of accidents. In 1925, more than forty states contributed to the production of stone in the United States, and in more than 34 of these states accidents were suffered by the men who produced the stone. To the extent that quarry accidents are similar regardless of location of plants, it would seem that the national associations might with advantage undertake a study of the accident-prevention problem. It has already been said that the quarry industry is less hazardous than coal and metal mines both as regards accident frequency and accident severity. This, however, is no more than might reasonably be expected because nearly all quarry work is done in the open daylight whereas most of the operations at coal mines

and metal mines are conducted underground where the light, which is necessarily artificial, is often not adequate for maximum safety; also in the underground work, there is the additional hazard of falling overhead material. The quarry industry should therefore not be content if it merely maintains an accident rate better than that for the mining industry, but should strive to lower its rate from its own previous levels. This has already been done to some extent so far as fatal accidents are concerned but not to any material degree as regards injuries of a nonfatal character.

Of the 92,000 men working at quarries in 1925, the operator's returns to the Bureau of Mines showed 52,000 working in and about the quarry pits and 40,000 working at the outside plants. About three-fifths of the accidents occurred to the men working in and about the pits. These accidents accounted for 101 deaths and 8,632 lost-time injuries. The fatality rate per thousand 300-day workers was 2.28 and the injury rate was 195. The injury rate was the highest on record since 1915 when the statistics for inside and outside accidents at quarries were first segregated. On the other hand, the fatality rates previous to 1925 were, in four cases, better, and, in six cases, worse than the rate in 1925. These figures show that more progress has been made in the prevention of fatalities than in the prevention of injuries. A comparison of these figures with those for outside plants shows that more progress has been made outside than inside the quarries, and this fact has contributed favorably to the record for the industry as a whole.

The number of days a quarry is in operation is largely a matter of contracts and weather conditions. Perhaps choice plays little or no part. Yet it may be interesting to know that it is apparently safer for a quarry to work full time than part time. That is to say, the accident rate per day diminishes as the number of days the plant is in operation increases. A quarry that is in operation a full year is likely to have a lower accident rate per day than if it worked only half a year. This conclusion is based on statistics which the Bureau has compiled for metal mines, which indicate a relationship between accident rates and continuity of operation which doubtless exists in quarries as well as mines.

These statistics (as yet unpublished) of metal-mine accidents show that accidents occur less often when operations are most continuous—that is, the accident rate declines as the number of operating days of the plant increases. This fact was indicated not only by

the figures for all classes of metal mines combined, but also by the figures for individual groups. The combined rate over a four-year period (1921-1924) for fatal accidents among underground employees was 7.69 per thousand full-time (300-day) employees for mines operating less than 100 days per year and it was 3.77 for mines operating 300 or more days per year. The nonfatal injury rate for the former group was 675 per thousand employees, while for the latter group it was 356. Considering mines of equal or similar size, the death rate for mines employing 100 or more men underground was 8.78 for 1 to 99 days of operation and 3.71 for 300 or more of operation. When the mines were classified according to principal product, it was found that iron mines operating less than 100 days had a fatality rate of 11.92 and an injury of 836, whereas those in operation 300 days or more had a fatality rate of 3.01 and an injury rate of 174. Similarly, copper mines had a death rate of 7.58 and an injury rate of 841 for less than 100 days of operation and a fatality rate of 4.09 and an injury rate of 435 for 300 or more days of operation. These figures for metal mines were for extreme groups in respect to operating time; rates for adjacent groups indicated the same tendency, but less clearly.

Similar figures for quarries have not as yet been compiled, but we hope to be able to prepare them in the near future.

The experience of 44 plants in the National Safety Competition of 1926 was classified on a monthly basis to learn the seasonal variation in the amount of exposure and the seasonal variation if any in the accident frequency rate. These 44 plants had a total exposure of 7,815,377 man-hours. The severity rates were also calculated on a monthly basis, but the occasional occurrence of a fatality, with its equivalent of 6,000 days, rendered the severity rates too variable for comparative purposes. The volume of exposure, as might be expected, reached its lowest level during the winter,—in January; it increased steadily through June, and held this level through July, then declined slightly but steadily through August, September, and October, and continued to decline more rapidly in November and December. The maximum exposure, in June, was $2\frac{1}{4}$ times that of January. The frequency of accidents was smallest during the four winter months of November, December, January and February; it was much higher in other months, the average rates being about 50 per cent higher for the months of greatest activity.

In order to form a mental picture of the field that lies ahead of any prospective safety program, it may

be helpful to state that so far as quarry safety rests with the operators, it is necessary to reach only a small number of companies to encompass a large proportion of the employees. Less than 700 quarries employ as many as 25 men in the pit and these 700 or less plants employ 80 per cent of all men that work at quarries in the United States. If 50 men inside the pit are considered necessary to entitle a plant to rank as a large quarry, then such plants number less than 300 and they employ nearly 60 per cent of the total quarry workers in the United States. These facts are referred to because the cooperation of the company as well as the employees must be obtained to make safety work effective. A relatively small number of companies have it within their power to give a tremendous impetus to quarry safety work that will benefit 80 per cent or more of the entire industry.

The accident rates for the whole quarry industry are but slight indication of what individual companies can accomplish. For example, the industry's accident-severity rate for work inside the pits, as nearly as it can be computed from available records, was 8.202 in 1925 and 6.931 in 1924; the corresponding group rate for companies in the National Safety Competition was 7.599 in 1925 and 7.760 in 1926. Yet in the 1925 safety contest, seven quarries out of 102 and in the 1926 contest fourteen quarries out of 118 operated their plants the entire year without a lost-time accident. In 1925 sixty plants or 59 per cent of those enrolled had accident-severity rates of less than 1 and in 1926 67 plants or 57 per cent had rates of less than 1. Thus it is seen that the group average of 8.202 in 1925 and 6.931 in 1924 for the whole industry, and the National Safety Competition group averages of 7.60 and 7.76, respectively in 1925 and 1926 are by no means the best that individual quarries can do in the elimination of accidents to their employees. In fact, the 1926 contest showed that 97 plants or 82 per cent of the total number had accident-severity rates that were better than the group average; 21 plants or 18 per cent of the total number had rates that were higher and therefore worse than the group average. This means that 18 per cent of the companies were mainly responsible for the group average being as high as it was. Had it not been for the many good companies, the rate would have been much higher. The record, in fact, showed that the companies whose rates were better than the average had a group rate among themselves of 2.314 while the rate for those whose record was worse than the average was 38.695; 2.314 for the good companies; 38.695 for the bad companies, an average of 7.760 for both combined. The

bad companies had a rate that was more than 16 times that of the good companies.

The purpose of these and similar statistics is to make it possible for individual quarries to compare their accomplishments in accident-prevention with what has been done by other companies. Any individual company may be remarkably successful in the elimination of certain classes of accidents and equally unsuccessful in combating other types. Neither the degree of success nor the degree of failure can be known without some standard of measurement. The National Safety Competition of 1926 has shown that while all of the quarries combined had a group rate of 7.760 yet 82 per cent of them had lower rates than that figure. The rates ranged from zero to more than 200. Rates for the individual companies have been published, but in such a way that the identity of each company is concealed. Each company has been advised of its own rate and of its relative standing among all companies. Copies of a circular containing these rates are available to any company upon request. Incidentally it may be stated that the circular also contains the rates of coal mines, metal mines, and non-metallic mineral mines. All of these rates have been calculated on a uniform basis and are therefore strictly comparable. The method of compilation is simple. Any company may easily prepare its own accident records in the same way. Those companies that see fit to do so will find that they are following a practice that has become standard not only in the mineral industry but in other industries as well. Following such a practice any company may readily learn how it ranks with other plants of the same type or with any other industrial unit. It is hoped that the companies represented at this meeting may find it practicable to place their accident statistics on this standard and widely accepted basis. In the event that any company establishes a safety record better than those indicated in the National Safety Competition, the Bureau of Mines would appreciate it if the company making the record would inform the Bureau of the fact. The Bureau desires to learn of cases of this kind so that suitable public recognition may be given.

A Completed Contract

"How's this?" asked the lawyer of the contractor. "You've named six material dealers in your will to be your pallbearers. Would you not rather choose some of your friends with whom you are on better terms?" "No, Judge, that's all right. Those fellows have carried me so long that they might as well finish the job."

Reduced Fares To West Baden Assured

Everyone will recall in connection with each of our past conventions how it has been necessary to hammer and hammer on the importance of each delegate's obtaining his return ticket certificate when purchasing his going ticket to the convention; how it has been necessary to collect these certificates during the convention and if the required number of 250 were obtained to have them validated by a representative of the railroads; how the certificates had then to be distributed to the respective delegates who turned them in, and finally, how the delegate had to present the certificate to his ticket agent before being permitted to purchase his return ticket for half price. Unfortunately, too, many of us can remember that embarrassing moment when announcement was made from the convention platform requesting that all certificates be turned in at the registration desk for validation, reminding us that in the rush of getting away we had completely overlooked asking for a certificate when purchasing our ticket, thereby jeopardizing everyone's chances of obtaining half fare returning.

It should be, therefore, decidedly gratifying to hear that much of the annoyance and inconvenience involved in the half-fare certificate plan as mentioned above has been eliminated by the decision of the railroads to authorize in connection with the West Baden Convention, the Identification Certificate Plan. Whether or not this plan should be granted was very largely determined on the basis of the record established at our previous conventions, where in each case for a number of years, it has been possible to validate more than two hundred fifty certificates. In this connection the sincere and grateful appreciation of the entire industry is due those delegates in attendance at our past conventions whose cooperation has made it possible to establish this excellent record.

Probably the most important feature of the Identification Certificate Plan which will be in effect for the West Baden Convention is the fact that the condition, heretofore existent, that two hundred fifty certificates must be validated in order to obtain half fare returning has been entirely eliminated. In other words, every delegate planning to attend the West Baden Convention has positive assurance, well in advance of the meeting, that if the simple requirements of the railroads are complied with, he can purchase a round-trip ticket to the convention on the basis of fare and one-half.

This feature should particularly appeal to all executives who contemplate taking their superintendents and operating men to the Convention as they can now definitely forecast their expenses for transportation which has not been possible in past years due to the ever-present possibility that the required two hundred fifty certificates might not be validated.

The operation of the Identification Certificate Plan is exceedingly simple and free from annoyance. Identification certificates will be printed and distributed well in advance of the meeting, through the Secretary's Office, to all expecting to attend the Convention. Each delegate in purchasing his transportation to the Convention will be sold, upon presentation to the ticket agent of the Identification Certificate mentioned above, a round-trip ticket to West Baden on the basis of fare and one-half times the regular one-way fare. Ticket agents will not be able to provide delegates with certificates as has been the case in the past. All certificates must be procured from the Secretary's Office in Washington. General distribution of these certificates will be made throughout the industry as soon as they are received from the printer and every effort will be made to see that everyone contemplating attendance at the West Baden Convention receives one. Individual certificates are required for each ticket sold, except that dependent members of a delegate's family are covered by the delegate's certificate.

As soon as the distribution of certificates has been made, notice to this effect will be given in The Crushed Stone Journal and in the trade press. Anyone who at that time has not received a certificate should immediately write to the Secretary's Office requesting that one be sent to him. It would greatly simplify and expedite the distribution of certificates if all who are expecting to go to West Baden would write in now to the Washington Office requesting that certificate be forwarded to them. This would be particularly helpful in the case of executives who are planning to take a number of representatives from their plants.

In the event that for any reason whatever a ticket agent refuses to sell you a round-trip ticket at reduced fare upon presentation of your Identification Certificate (this could only occur at very small stations) be sure to obtain receipts for your one-way fare to West Baden as well as for the return fare. The obtaining of these

receipts will make it possible for you to get a rebate after you return from the Convention.

For the guidance of delegates in purchasing their transportation to West Baden there is given below a table showing dates on which tickets must be purchased and date of final return limit.

Territory	Dates of Sale (inclusive)	Return Limit*
Central Passenger Association.....	January 12-18	January 25
Trunk Line Association.....	January 12-18	January 25
New England Passenger Association	January 12-18	January 25
Southeastern Passenger Association	January 12-18	January 25
Southwestern Passenger Association		
1. Oklahoma and Texas (except El Paso)	January 11-17	January 26
2. El Paso, Texas.....	January 11-17	25 days
3. Arkansas, Louisiana	January 12-18	January 25
Transcontinental and Western Passenger Associations		
1. Colorado (Julesburg only), Illi- nois, Iowa, Kansas, Minnesota, Missouri, Nebraska, Northern Michigan, North Dakota, South Dakota and Wisconsin.....	January 12-18	January 25
2. Colorado (except Julesburg), Montana, Wyoming	January 11-17	22 days
3. New Mexico.....	January 11-17	25 days
4. Utah	January 10-16	25 days
5. Arizona, Idaho (Oregon short line)	January 8-14	25 days
6. California, Idaho (except Ore- gon short line), Nevada, Oregon and Washington	January 8-14	30 days after sale
Canadian Passenger Association (Eastern Lines) (not heard from as yet).		

*Delegates may leave West Baden on any date to and including final return limit, but must reach original starting point prior to midnight of final limit.

The number of identification certificates turned in will to a large extent determine whether or not reduced fares can be obtained under this plan for next year and consequently everyone is urgently requested to make use of the certificates even though the saving due to their close proximity to West Baden may be negligible. The certificates can and should be used wherever the round-trip reduced fare amounts to \$1.00 or more.

Wisconsin Aggregate Producers To Meet

We have just received word from G. F. Daggett, Executive Secretary, Wisconsin Mineral Aggregate Association, that the Ninth Annual Meeting of this organization will be held at the Astor Hotel, Milwaukee, on December 7th and 8th. Papers and discussions on topics of interest to the industry will feature the two-day session which will close on Thursday evening with the Annual Dinner.

In connection with the meeting, manufacturers of machinery and allied interests will be present with ex-

hibits of literature and in some cases small working models of machinery.

Everyone interested is most cordially invited to attend this meeting.

Southwestern Division Favors Testing Laboratory

During a meeting of the Southwestern Division held in Dallas, Texas, on September 9th, the question of establishing a research testing laboratory in conjunction with the Bureau of Engineering of the National Association was very thoroughly discussed. It was pointed out that the Bureau was at present operating under a decided handicap in not having such a laboratory, and that this lack of facilities makes it necessary to interest outside agencies in conducting researches which should more properly be undertaken by ourselves. In support of this opinion the following resolution was unanimously adopted:

"That it is the sense of this meeting that all initial research should be made first by the National Crushed Stone Association and that the Southwestern Division of the N. C. S. A. will lend its support to the best of its ability in the establishment of a laboratory for the N. C. S. A."

The Southwestern Division is to be highly commended for its action in this regard and we wish to express our deep appreciation for its pledge of support towards the establishment of our testing laboratory.

Radio Stuff

A June bride asked her husband to copy a radio recipe one morning. The husband did his best, but got two stations at once. One was broadcasting the morning exercises and the other the recipe. This is what he got: Hands on hips, place one cup of flour on the shoulders, raise knees and depress toes and wash thoroughly in one-half cup of milk. In four counts raise and lower the legs and mash two hard-boiled eggs in a sieve. Repeat six times. Inhale one-half teaspoonful of baking powder and one cup of flour, breathe naturally and exhale and sift. Attention! Jump to a squatting position and bend white of egg backward and forward over head and in four counts make a stiff dough that will stretch at the waist. Lie flat on the floor and roll into a marble the size of a walnut. Hop to a standstill and boil in water, but do not boil into a gallop afterwards. In ten minutes remove from the fire and dry with a towel. Breathe naturally and dress in warm flannels and serve with fish soup."—*Clift*.

THE PRESIDENT'S PAGE

ABOUT two weeks ago Mr. Boyd and I visited for a day and a night our next convention headquarters, the West Baden Springs Hotel. It is difficult to imagine a hotel which could accommodate us more comfortably and pleasurably, or more adequately satisfy our rather exacting requirements. It is circular in shape and the large central room which is called the atrium is one of the most attractive I have ever seen. In this central room, some two hundred feet in diameter, with the roof seven or eight stories above the floor, the exposition will be held, the booth arrangement conforming very pleasingly to the circular shape. The exposition, therefore, will be so centrally located that it will be constantly observed and inspected, as one must pass through it to go from the lobby to the dining room, to the mineral springs, to the taxicab entrance or, in fact, in going anywhere about the lower floor of the hotel. The Manufacturers are delighted with the arrangement and there is no doubt that the available booth space will be subscribed for more rapidly by a larger number of exhibitors than ever before.

It is difficult to describe the opportunity that will present itself to develop to an even greater extent than heretofore the good-fellowship and camaraderie characteristic of our gatherings. There will be but few, if any, guests in the hotel other than those attending the convention; there are no attractions outside of the hotel other than the delightfully hospitable Hoosier Club, and we shall all be thrown together more intimately, as though house guests on a large country estate.

Because of the necessity of providing our own amusement, the Entertainment Committee, under the chairmanship of Col. Tyler of Louisville, Ky., and with Indiana producers actively engaged in the work of the committee, is arranging elaborate entertainment features imported from Chicago and Louisville. It is but a conservative and inadequate expression to state that the entertainment will far surpass any ever before presented at our previous conventions.

It is as yet too early to announce any of the speakers on the sessions' program, but it is assured that addresses will be delivered by nationally recognized authorities.

While fully recognizing the intellectual advantages and pleasurable attractiveness of previous conventions, I believe that the coming one at West Baden will ex-

ceed all others in these two respects. The location, only thirty-two miles from the center of population, could hardly be surpassed, and if all of our members could have had the opportunity of studying this site with me, I have but little doubt that all previous attendance records would be broken.

The special rates offered by the hotel will naturally reduce the cost to those attending, thereby enabling each company to send two or three additional representatives without increasing the total cost as compared to past conventions.

Special cars will be run from Chicago, Buffalo, St. Louis, New York, Philadelphia, and from possibly one or two other points, straight through to West Baden without change. Further details as to this will be published in due time.

* * * * *

The request recently sent to all of our active members to contribute \$100 for each 200,000 tons of production or fraction thereof to a fund for establishing a testing laboratory in Washington has met with a gratifying and encouraging response. The contributions asked for were on a modest and moderate basis, in the belief that it is better to have the fund raised by contributions from all of our members than by large amounts from a relatively small number.

It will be as encouraging to you as it is to me to know that one of the first fifteen pledges received was from our western Vice President, Mr. A. R. Wilson of California. While it is obvious that the work of the Bureau of Engineering, enlarged, amplified and rendered more effective, as it will be by means of a testing laboratory, is of equal advantage to the producers in California, Texas and Canada as to those in the more central states, it is none the less gratifying to realize that they perceive this fact, and though they do not meet with the rest of us so frequently because of geographic location, they are none the less joining wholeheartedly in advancing the interests of the Association in order that the industry throughout the length and breadth of this land will prosper thereby.

Our various local associations are each undertaking, either as an association or individually through their members, to raise assigned quotas to contribute to the fund. It has already been made clear that the pledge of any member of the National Association will be applied to the amount raised by any local association of which the contributor is a member.

The Manufacturers forming our associate membership have undertaken to raise the sum of five thousand dollars, and we are still hopeful that a group of the explosives' manufacturers will contribute liberally.

If each of our members contributes on the basis requested there is but little doubt that a well-equipped laboratory under the able direction of Mr. Goldbeck will be assured. It is so easy to lay aside the pledge form, thinking to fill it in at some later time. If you have not already mailed it, will you not sign it for the amount of your contribution right now and mail it at once? It is but a small amount to pay for insurance as to our present market and to enable us to seek for an even larger and wider one.

* * * * *

On October 21st at the Commodore Hotel, New York, was held the annual meeting of the Manufacturers' Division, with some fifty at the dinner arranged by Mr. Gordon Buchanan with his usual skill and ability. The presiding officer was Mr. C. B. Andrews, the acting chairman of the Division.

After the dinner was concluded, a business session was held, the discussion largely centering around the exposition at the next convention, for which definite plans were laid. Throughout the meeting of the Manufacturers, there was an evident spirit of a desire to co-operate with the Association and to further its interests, culminating in the Division undertaking to raise five thousand dollars toward the fund for establishing a laboratory. Throughout the life of the Manufacturers' Division it has shown itself not only willing, but eager to assist us in our undertakings and quick to catch the spirit of our underlying aims and ambitions. As an association, we are indeed fortunate in having such a helpful and co-operative associate membership and we are glad for their sakes, as well as our own, that the exhibition facilities at West Baden are so highly attractive.

Earlier in the same day the Executive Committee met for luncheon, together with some eight or ten members of the Board of Directors. During the meeting, plans for the next convention were discussed and arrangements made to insure its success. Due consideration was given to the plans for raising an adequate fund for establishing a testing laboratory, and other matters of detail, though important in themselves, were determined. It is not only encouraging, but inspiring, to have so many of our officers lay aside their various personal duties and devote the several days required in traveling and in the meeting itself in an effort to advance our mutual interests.

If You are Doing Forty-five, How far are You Going in a Second? Ever Figure it Out

Miles per Hr.	Feet per Sec.	Miles per Hr.	Feet per Sec.
10	14.66	35	51.33
15	22.00	40	58.66
20	29.33	45	66.00
25	36.66	50	73.33
30	44.00		

Sixty-six feet per second—that is the distance you are traveling every second if you are doing forty-five miles.

That is exactly the distance across the road from fence to fence.

Figures and estimates like these have vital bearing upon matters of safety on public highways in these days of high speed motor vehicles.

If you have brakes on two wheels only you can't expect to stop, according to the best records, short of 187 feet—three times the distance across the road.

If you have four wheel brakes you may be able to stop in 124 feet—twice the distance across the road.

That is the best you can expect to do with everything in perfect order, dry road, good brakes, and everything, including yourself, in tip-top A-1 shape.

If you are going fifty miles an hour you are doing 73.33 feet every second of time and it will take you at the best you can do, nearly a city block to get stopped. At seventy-five feet per second do you wonder that you and your car can be off the road, in the ditch, upside down, and you dead, inside of a single second?

Many drivers have a faculty amounting to almost a sixth sense when it comes to estimating almost the exact spot where two approaching cars will be at the moment of passing even though each may be passing at greatly varying speeds. When this sense or faculty fails to function properly when both a car and a railroad train are approaching a crossing at the same time, tragedy results.

Study the table at the head of this article—get the figures for 20, 30 and 40 miles per hour in mind—then practice estimating how long it takes you to reach, for instance, a railroad crossing or a dangerous turn. You will probably be astonished at how quickly you approach such points and how quickly things may happen when you are doing just thirty miles per hour.

—Iowa Service Bulletin.

Manufacturers' Division Holds Annual Dinner Meeting

Following a custom of many years' standing, the Manufacturers' Division of the Association held its annual pre-convention dinner meeting on October 21 at the Commodore Hotel, New York City.

Representatives from a large number of the firms composing our associate membership were present as were also the officers of the National Association and a number of members of the Executive Committee and Board of Directors.

From past experience we have come to expect, at this annual function, a dinner of surpassing excellence, but the one served this year completely convinced us that Gordon Buchanan, who had in charge all arrangements, is most eminently fitted for this office. It is hereby suggested that he be retained to act in this capacity indefinitely. From soup to nuts, the dinner was beyond comparison and in appreciation of the service rendered by Mr. Buchanan in making all the preparations a rising vote of thanks was extended to him at the conclusion of the evening.

The meeting which directly followed the dinner was called to order by C. B. Andrews, Acting Chairman of the Division. Mr. Andrews paid a gracious and fitting tribute to the two past presidents present, John Rice and Scott Eames, in asking them to be the first speakers of the evening.

President Graves, who directly followed them, outlined the plans by which it is expected to raise the necessary funds for the establishment of a research testing laboratory to be operated in conjunction with the Bureau of Engineering. His suggestion that the Manufacturers' Division assist in this work by contributing \$5,000 met with the whole-hearted response which is characteristic of the Division and it forthwith voted to undertake to raise this amount in money or laboratory equipment. President Graves stated that the subscriptions from active members were coming in at an encouragingly rapid rate, totaling to date between \$4,000 and \$5,000, which gave excellent assurance that the total amount expected from our active members, between \$10,000 and \$15,000, would rapidly be realized. In addition to contributions from active members and the Manufacturers' Division, he stated that it was confidently expected that the powder manufacturers would contribute between \$10,000 and \$15,000 which would

assure the total fund necessary to properly equip and operate a very creditable testing laboratory.

Colonel Brink Tyler of Louisville, Kentucky, Chairman of the Entertainment Committee for the West Baden Convention, when called upon to tell us what was planned for our evenings during the convention, was strangely reticent and we suspect, judging from the reputation which he established during the Louisville Convention, that the entertainment at West Baden will live long and vividly in our memories as one of the most pleasant experiences of the convention.

Brief remarks were then heard from A. S. Lane, F. C. McKee and C. M. Doolittle, members of the Board of Directors of the National Association, all of whom the Manufacturers' Division was honored in entertaining for the first time at one of their annual meetings.

A. T. Goldbeck, Director of the Bureau of Engineering, discussed in brief the needs of the Association for a research testing laboratory and expressed his gratification that the Manufacturers' Division was going to contribute so generously towards the funds necessary for its establishment.

It was voted to extend an invitation to the Bureau of Mines, the National Safety Council, the Clarence Blakeslee Company and the National Crushed Stone Association to exhibit at the West Baden Convention without charge for space.

N. S. Greensfelder, Chairman of the Committee on Welfare and Safety of the National Association, stated that arrangements had been made with the United States Bureau of Mines whereby their mine rescue car would be at West Baden during the convention and that demonstrations would be given by two specially trained quarry crews from the France Stone Company and the Mid-West Crushed Stone Company.

A telegram from D. C. Souder, Chairman of the Quarry Section of the National Safety Council and Director of Insurance and Safety for the France Stone Company, asking for the cooperation of the Manufacturers' Division in properly safeguarding machinery and equipment before shipping same to the purchaser was read to the meeting. In response to this request it was voted that a committee be appointed, composed of both active and associate members for the purpose of studying this problem.

Chairman Andrews reported the action taken at a meeting held earlier in the day of the Regional Vice-Chairmen of the Division, stating that it had been decided to charge for the exposition space at the rate of \$45.00 per booth; that the assignment of booth space would be made by a committee composed of H. M. Davison, The Hayward Company; L. W. Shugg, General Electric Company, and J. R. Boyd, Secretary; that this committee would meet for the purpose of allocating space approximately three weeks after information with regard to the Exposition had been distributed from the Secretary's Office, thus insuring an equal opportunity for obtaining the more desirable booths to all firms, regardless of their geographical location with respect to the Washington Office; and that the Division would cooperate with the national officers in stimulating attendance at the various convention sessions by closing their exhibits during these sessions. The report of Chairman Andrews was approved without change.

Following is a list of the manufacturers' representatives in attendance at the meeting:

C. B. Andrews, Taylor-Wharton Iron & Steel Co. High Bridge, N. J.
 Walter Annette, Hercules Powder Company, New York City.
 Gordon Buchanan, C. G. Buchanan Co., New York City.
 Ralph C. Becker, McGraw Hill Catalog & Directory Co., New York City.
 A. H. Beegs, McGraw Hill Catalog & Directory Co., New York City.
 Benj. F. Clark, Jr., American Manganese Steel Co., New York City.
 S. E. Cole, Pit and Quarry, New York City.
 H. M. Cooper, Sauerman Bros., Inc., New York City.
 H. M. Davison, The Hayward Co., New York City.
 B. G. Dann, Hendrick Mfg. Co., Carbondale, Pennsylvania.
 George M. Earnshaw, Rock Products, New York City.
 G. D. Fraunfelder, Easton Car & Construction Co., Easton, Pa.
 Edward Feunerty, Vulcan Iron Works, New York City.
 George Flounders, C. G. Buchanan Co., New York City.
 C. H. Gibbons, Marion Steam Shovel Co., New York City.
 M. B. Garber, The Thew Shovel Co., Lorain, Ohio.
 N. S. Greensfelder, Hercules Powder Co., Wilmington, Del.
 J. C. Houston, Browning Crane Co., New York City.
 J. A. Lang, E. I. duPont de Nemours & Co., New York City.
 E. G. Lewis, Bucyrus Company, New York City.
 W. F. Nothacker, Sanderson-Cyclone Drill Co., New York City.
 W. S. Nicol, Cross Engineering Co., Carbondale, Pa.
 O. B. Niesen, Trojan Powder Co., Allentown, Pa.
 W. H. Norrington, Robins Conveying Belt Co., New York City.
 N. C. Rockwood, Rock Products, Chicago, Illinois.
 S. R. Russell, E. I. duPont de Nemours & Co., Wilmington, Del.
 Albert E. Reed, W. S. Tyler Company, Cleveland, Ohio.
 L. W. Shugg, General Electric Co., Schenectady, N. Y.
 J. C. Taylor, Jr., Taylor-Wharton Iron & Steel Co., High Bridge, N. J.
 James R. White, The Hayward Company, New York City.
 In addition to the above the following were also present:

Sectional Committee On Testing Road Materials Organized

The American Society for Testing Materials is sponsor under A.E.S.C. procedure for the development of standard methods of test of road and paving materials. It has formed a sectional committee on this subject by adding to the personnel of Committee D-4 on Road and Paving Materials officially appointed representatives of a number of organizations, some of which have been informally represented for some time and others of which have not been heretofore represented officially. The associations that are now formally represented on the committee are: American Association of State Highway Officials, American Concrete Institute, American Electric Railway Association, American Petroleum Institute, American Road Builders Association, American Society of Civil Engineers, American Society for Municipal Improvements, Asphalt Association, Associated General Contractors of America, Eastern Stone Association, Granite Paving Block Manufacturers Association, National Sand and Gravel Association, National Crushed Stone Association, National Paving Brick Manufacturers Association, National Slag Association, Portland Cement Association, U. S. Bureau of Public Roads, and U. S. Bureau of Standards. The committee contains 80 members, classified into producers, consumers and general interests.

The personnel has been submitted for approval of the American Engineering Standards Committee. When such approval has been given the committee will take up consideration of submission of existing methods for approval by the A.E.S.C. as American Standard, including revisions that have been made since original approval by the A.E.S.C. as Tentative American Standard of the Standard Methods of Test for Penetration of Bituminous Materials (D5-25) and the Tentative Method of Test for Distillation of Bituminous Materials Suitable for Road Treatment (D 20-27 T).—*Rock Products.*

J. R. Boyd, Nat'l Crushed Stone Ass'n, Washington, D. C.
 C. M. Doolittle, Canada Crushed Stone Corp., Hamilton, Ont.
 Scott Eames, New Haven Trap Rock Co., New Haven, Conn.
 A. T. Goldbeck, Nat'l Crushed Stone Ass'n, Washington, D. C.
 Otho M. Graves, General Crushed Stone Co., Easton, Pa.
 F. T. Buckner, John T. Dyer Quarry Co., Norristown, Pa.
 A. S. Lane, John S. Lane & Son, Inc., Meriden, Conn.
 John Rice, General Crushed Stone Co., Easton, Pa.
 James Savage, Buffalo Crushed Stone Co., Buffalo, N. Y.
 F. W. Schmidt, Jr., Morris County Crushed Stone Co., Morristown, N. J.
 W. L. Sporborg, Rock-Cut Stone Co., Syracuse, N. Y.
 A. L. Worthen, Connecticut Quarries Co., New Haven, Conn.

The Crushed Stone Journal

J. R. BOYD, Editor

A. T. GOLDBECK, Director, Bureau of Engineering

The National Crushed Stone Association

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Drake Building
Easton, Pa.

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W. F. Wise (Southwestern) A. R. Wilson (Western)

C. M. Doolittle (Canadian)

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C. M. Doolittle

E. J. Krause

H. E. Blair

W. Scott Eames

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Built-Up Roads In Europe

There is an idea current among some engineers that crushed stone foundations will not sustain heavy loads. In many cases, more or less perfect crushed stone or gravel roads have been torn up ruthlessly on the ground that the road was too weak—and thinner roads of other materials constructed.

In this respect modern country road construction has suffered from the effect of city pavement practice. In cities where stone or gravel streets have been materially weakened by frequent cuts through the surface for the installation or repair of public utilities and the cuts have been carelessly mended, the charge that the old road is too unstable to be trusted often is well founded. But on country roads such cuts through the pavement are infrequent and the road is uniformly strong as when built, except for the surface wear of traffic.

Anyone who has seen the steam lorries plying over the English stone roads hauling loads up to 30 tons cannot doubt the supporting power of crushed stone. English roads are built-up with crushed stone—each generation adds its quota—and they carry the loads beautifully. It seems like a sinful waste to destroy an old foundation for any other purpose than to correct alignment or improve grades.

Here is another reason why we need good engineering in the laying out of roads—it makes built-up roads possible.—*Highway Engineer and Contractor.*

Washington University Students To Study Bulletin No. 3

Probably the most distinctive compliment which has yet been paid to the work of our Bureau of Engineering and particularly to the publication of our engineering bulletins comes in the form of two letters written to Col. E. J. McMahon, Executive Secretary of the St. Louis Quarrymen's Association, asking if he could provide copies of Bulletin No. 3 for the use of the senior students in architecture and civil engineering of Washington University, St. Louis.

These two letters so clearly reflect the very favorable reception which has been accorded our engineering bulletins that permission to publish their letters was obtained from Professors Fitch and Sweetser.

Ferrand and Fitch
Architects

Washington University
St. Louis

October 15, 1927.

St. Louis Quarrymen's Assn.,
3800 W. Pine Blvd.,
St. Louis, Mo.
Gentlemen:

We have received your complimentary copy of Bulletin No. 3, The Water-Ratio Specification for Concrete and Its Limitations.

I would indeed appreciate it if I could have about thirty copies for distribution to the students in the Senior Class at the School of Architecture of Washington University.

Yours very truly,
(Signed) A. E. FITCH.

* * *

Washington University
St. Louis

October 24, 1927.

St. Louis Quarrymen's Association,
3800 West Pine,
St. Louis, Mo.
Gentlemen:

It is our purpose in the Civil Engineering Department of Washington University to keep the information before our students as much up-to-date as possible and in view of that fact I am wondering if your organization would care to issue copies of your Bulletin No. 3 on the "Water-Ratio Specification for Concrete and Its Limitations" by A. T. Goldbeck. I have two classes who are studying concrete and giving especial attention to the study of the water-cement ratio at this time so that the Bulletin No. 3 would be especially appropriate. One of these classes is made up of the seniors in Civil Engineering and twenty-five copies of the Bulletin would supply the whole class.

The other class is made up of night students who come from a great number of engineering offices in and near the city, and twenty-five copies of the Bulletin would supply all the members

of that class. I make this distinction between the two classes because should you not care to consider supplying a total of fifty copies for both classes, it is possible that you would be favorably disposed to supplying enough for the senior Civil Engineers.

Trusting that I may hear favorably from you in regard to this matter, I remain

Very truly yours,
(Signed) E. O. SWEETSER,
Professor of Structural Engineering.

There is probably no more fertile field for the dissemination of the information contained in the publications of the Bureau of Engineering than in the civil and architectural engineering class rooms of the colleges and universities of the country. These students are the potential highway and construction engineers of tomorrow and as such should be correctly and completely informed as to the materials with which they will have to work. It is distinctly gratifying to learn that the first step in this direction has been taken.

Increased Federal Aid For Road Building Urged

Senator Oddie (Rep.) Nevada, speaking November 11, at the dedication of the new Market Street Bridge at Wilmington, Delaware, discussed Federal Aid of

road building, and said that the Government is under an obligation to continue the program mapped out in the law of 1916. This program, he said, calls for annual Federal appropriations of \$75,000,000 for Federal aid and an additional \$7,500,000 to be spent on roads in national forests.

Amendments to the present Federal Highway Act were suggested by Senator Oddie in the following respects:

To provide for a higher percentage of the cost of building roads in sparsely settled areas to be paid by the Federal Government;

To eliminate the present limit of \$15,000 per mile upon Federal payments for roads built jointly with the States.

Increase in Federal appropriations to provide connecting links in the national road system; and

Elimination of private billboards, sign boards, and other roadside advertising along the national highways.

The road building program is of importance, he said, not only to the West, where there is great need for improved roads, but also to the Eastern States which, he predicted, will soon be face to face with the necessity of widening many of their new principal roads and constructing many new highways to handle increasingly congested traffic.

Associate Members of the National Crushed Stone Association

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Crushing Plants and Machinery.

American Manganese Steel Co., Chicago Heights, Ill.
"Amsco" Manganese Steel Castings.

American Tar Products Co., Union Trust Bldg., Pittsburgh, Pa.
Tar Products for Road Construction and Maintenance.

Armstrong Manufacturing Co., Waterloo, Iowa.
Blast Hole Drills, Bit Dressing Machines.

Atlas Powder Co., Wilmington, Del.
Explosives and Blasting Accessories.

Earle C. Bacon, Inc., 26 Cortlandt St., New York City.
Complete Plants, Crushers, Elevators, Screens, Conveyors.

The Barrett Company, 40 Rector St., New York City.
Tarvia for Road Construction, Repair and Maintenance.

R. H. Beaumont Co., 319 Arch St., Philadelphia, Pa.
Crushers, Feeders, Elevators, Conveyors and Bunkers.

Blaw-Knox Co., P. O. Box 915, Pittsburgh, Pa.
Manufacturers of Steel Products.

The Browning Crane Co., 16226 Waterloo Rd. N. E., Cleveland, Ohio.
Locomotive Cranes.

C. G. Buchanan Co., Inc., 90 West St., New York City.
Crushers, Crushing Rolls, Magnetic Separators.

The Bucyrus Company, South Milwaukee, Wis.
Shovels—Steam, Diesel, Electric and Gasoline—and Dredges.

Buffalo Wire Works, 521 Terrace, Buffalo, N. Y.
Wire Cloth and Screens.

Burrell Eng. & Constr. Co., 513 West Jackson Blvd., Chicago, Ill.
Design and Construction.

Canadian Explosives, Limited, Canada Cement Bldg., Montreal, Canada.
Explosives and Blasting Supplies.

The Carroll Chain Co., 265 Hosack St., Columbus, Ohio.
"Carroll" Solid Weld Steam Shovel Hoisting Chains.

Cement Mill and Quarry, 542 Monadnock Block, Chicago, Ill.
"Publishers."

Cross Engineering Works, Carbondale, Pa.
Perforated Metals.

E. I. Du Pont de Nemours & Co., Wilmington, Del.
"Explosives of All Kinds and Blasting Accessories."

Easton Car and Construction Co., Easton, Pa.
Quarry Cars.

- Ensign-Bickford Co., Simsbury, Conn.
Safety Fuse and Cordeau Bickford Detonating Fuse.
- Fairbanks, Morse & Co., 347 W. 4th St., Cincinnati, Ohio.
Diesel Engines, Electric Motors.
- Fate-Root-Heath Co., Plymouth, Ohio.
"Plymouth" Gasoline Locomotives.
- Flexible Steel Lacing Co., 4607 Lexington St., Chicago, Ill.
Alligator and Flexco H. D. Belt Fasteners.
- Frog, Switch & Mfg. Co., Carlisle, Pa.
Manganese Steel Castings.
- General Electric Co., Schenectady, N. Y.
Electrical Apparatus and Supplies.
- Gill Rock Drill Co., Lebanon, Pa.
Blast Hole Drilling and Fishing Tools.
- Good Roads Machinery Co., Kennett Square, Pa.
Crushers, Elevators, Elevator Feeders and Revolving Screens.
- The Goodyear Tire and Rubber Co., Inc., Akron, Ohio.
Belting: Transmission, Conveyor, Elevator; Hose, Packing.
- Graham Coal Company, Commercial Trust Bldg., Philadelphia, Pa.
Coal and Coke.
- Grasselli Powder Co., Cleveland, Ohio.
Manufacturers of Explosives.
- Harnischfeger Corporation, 38th & National Aves., Milwaukee, Wis.
Gasoline, Electric and Diesel Shovels—Cranes, Draglines.
- The Hayward Co., 50 Church St., New York City.
Hayward Orange Peel and Clam Shell Buckets.
- The Hendrick Mfg. Co., Carbondale, Pa.
Perforated Metal Screens, Elevator Buckets.
- Heisler Locomotive Works, Erie, Pennsylvania.
Geared Locomotives.
- Hercules Powder Co., Wilmington, Del.
Explosives and Blasting Supplies.
- C. W. Hunt Co., 1580 Richmond Terrace, West New Brighton, N. Y.
Mitchell Electric Vibrating Screen.
- Ingersoll-Rand Company, 11 Broadway, New York City.
Rock Drills, Steel Sharpeners, Oil Furnaces and Hoists.
- The Jeffrey Mfg. Co., Columbus, Ohio.
Elevating and Conveying Machinery.
- Keystone Lubricating Co., Philadelphia, Pa.
Lubricating Greases and Lubricating Devices.
- Keystone Division, McGraw-Hill Catalog & Directory Co., Inc., 475 10th Ave., at 36th St., New York City.
Publishers of Metal Quarry Catalog and Metal Quarry Directory.
- Koehring Company, Milwaukee, Wis.
Gasoline Shovels, Cranes and Draglines.
- Koppell Industrial Car and Equipment Co., Koppel, Pa.
Quarry Cars in hand and air operated designs—Track Material.
- The Loomis Machine Co., Tiffin, Ohio.
Blast Hole, Prospecting and Drilling Machinery and Tools.
- Manganese Steel Forge Co., Richmond St. and Erie Ave., Philadelphia, Pa.
"Rol-Man" Screens, Chains, Plates and Forged Products.
- The Marion Steam Shovel Co., Marion, Ohio.
Power Shovels and Cranes—Steam, Gasoline and Electric.
- Mid-West Locomotive Works, Cor. Spring Rd. and Alabama Ave., Cincinnati, Ohio.
Quarry Locomotives.
- National Malleable & Steel Castings Co., 10600 Quincy Ave., Cleveland, Ohio.
Naco Cast Steel Steam Shovel Chain and Certified Malleable Castings.
- Niagara Concrete Mixer Co., 40 Pearl Street, Buffalo, N. Y.
"The Niagara Screen."
- The Ohio Locomotive Crane Co., Bucyrus, Ohio.
"The Ohio Crane."
- The Orville Simpson Co., 1230 Knowlton St., Cincinnati, Ohio.
Screens, ROTEX, level, self-cleaning, 100 to 3/4" mesh.
- The Osgood Company, Marion, Ohio.
Power Shovels and Combinations.
- Pit and Quarry, Rand McNally Bldg., Chicago, Ill.
"Publishers."
- Rock Products, 542 So. Dearborn St., Chicago, Ill.
"Publishers."
- Robins Conveying Belt Co., 15 Park Row, New York City.
Material Handling and Screening Equipment.
- The Sanderson-Cyclone Drill Co., Orrville, Ohio.
Drills, Big Blast Hole, Drilling and Fishing Tools.
- Sauerman Bros., Inc., 438 S. Clinton St., Chicago, Ill.
Cableway Excavators, Power Scrapers.
- Smith Engineering Works, 32nd and Locust Sts., Milwaukee, Wis.
Rock Crushers—Gyratory, jaw and reduction.
- The Stearns Conveyor Co., 200th St. & St. Clair Ave., Cleveland, Ohio.
Material Handling Machinery.
- Symons Bros. Co., 111 W. Washington St., Chicago, Ill.
Ore, Rock and Gravel Crushers.
- S. G. Taylor Chain Co., 140 So. Dearborn St., Chicago, Ill.
Taylor Mesaba Steam Shovel Chains.
- Taylor-Wharton Iron & Steel Co., High Bridge, N. J.
TISCO Manganese Steel Castings.
- The Thew Shovel Co., Lorain, Ohio.
Steam, Gasoline and Electric Shovels, Cranes, Draglines.
- The Traylor Engineering & Mfg. Co., Allentown, Pa.
Crushing, Cement and Mining Machinery.
- Traylor Vibrator Co., 1400 Delgany St., Denver, Colorado.
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- Trojan Powder Co., Allentown, Pa.
Explosives and Blasting Supplies.
- Troco Lubricating Co., Philadelphia, Pa.
Manufacturers of Petroleum Products.
- The W. S. Tyler Co., Cleveland, Ohio.
Woven Wire Screens and Screening Equipment.
- Union Explosives Co., Clarksburg, W. Va.
Explosives and Blasting Supplies.
- Vulcan Iron Works, Wilkes-Barre, Pa.
Steam, Gasoline, Electric Locomotives.
- Western Wheeled Scraper Co., Aurora, Ill.
Western Portable Rock Crushers.
- George D. Whitcomb Co., Rochelle, Ill.
Gasoline Locomotives.
- Williams Patent Crusher and Pulverizer Co., 813 Montgomery St., St. Louis, Mo.
Hammer Crushers.

JONES IS COMING!

ARE YOU? DON'T FORGET THE DATE!



National Crushed Stone Association Eleventh Annual Convention

West Baden, Indiana

January 16, 17, 18 and 19, 1928